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practically negligible. In measuring, the frame, which carries the setting microscope and the two scale microscopes, is moved on slides parallel to the $x$ and $y$ coördinates (the $x$-slide is on this frame and carries the setting microscope and one of the scale microscopes) until the intersection of two fixed wires in the setting microscope falls over the center of the star image. The scales are then read off directly in the scale microscopes, the interval between the nearest scale division and the fixed wire in the scale microscope being estimated to the nearest tenth. Thus no micrometers are used for making settings on the scale divisions. One of the disadvantages of the Stackpole machine is that it is not tilted, so that a person must stand stooped over it while measuring. In a differently designed machine this could be remedied, the scale microscopes could be more conveniently placed, and it might be an advantage to have the interval between scale divisions $0.01^{mm}$ instead of 0.001 inch ($0.025^{mm}\pm$).

As I understand it, for some unaccountable reason the reseau does not always reproduce itself exactly on the photographic plate, so that it is not entirely reliable where the greatest accuracy is desired. . . . For somewhat more approximate [less accurate] measures I will grant that the reseau has the advantage of a slightly greater speed, in that you read off the distances to the reseau-lines in the same microscope that is used for setting on the star. When you want greater accuracy of measurement, you will probably have to use micrometers for measuring the distances to the reseau-lines. In our way of using the scales, the scale divisions from which we take our readings are always very close to the optical axis of the microscopes.

If for any reason you should wish to remeasure an image, the reseau certainly would allow it to be done quickly. As a matter of fact, however, the direct and reverse settings give a check to the measures, and this check is always made before removing the plate.

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From Mr. Hinks's second letter, November 20, 1907:—

. . . I shall try to put briefly my explanations of the way I look at the points mentioned in your letter.

1. Some misunderstanding was caused by my ignorance of the Stackpole machine, which I have never seen described. I did not know that you *estimated* on ten scales to 0.0001 inch ($=0.0025^{mm}$). I always supposed that you measurements went to a somewhat higher degree of *apparent* precision, which would almost necessitate your using microscopes to subdivide the scale. On our machine we measure to $0.0005^{mm}$; and though we can't swear to the last figure exactly, I think we can, on a good object, be accurate to within a probable error of about 1 unit in the last place. I imagine that the p. e. of one of your estimates is very much the same,—that is, one unit of *your* last place, which is bigger than ours ($x$ 5). Have you investigated your personal scale—i. e. preference for 5 over 4 or 6 for example? that is often a serious

reason why estimated last places should be in units as small as possible.[1]

2. The "mechanical disadvantage" to which I referred is involved in the fact that in your type of machine you depend upon perfect straightness of the main slides. If you use a *reseau* the slides may be practically as bad as they like.

3. The fact of uniformity of coefficient of expansion is a strong argument for glass over metal, but does not affect the question *Reseau or not,* as far as I can see.

4. The *reseau* does not reproduce itself exactly, but the so-called "errors of projection" are pretty constant. This means that you must study the division errors of the copies—and study so many that the distortion of the film in each goes out in the mean. This of course is tiresome. But after all, the projection errors are not so large as the residual distortions of the gelatine you are prepared to admit. And as they are more nearly constant, and thus unimportant in much refined work such as stellar parallax, where absolute places are unimportant, I think the advantage still lies with the reseau.

5. . . . Optical distortion of the microscope does not come in if you work with a suitable objective of the first class. . . . A more frequent source of error in good machines is tilt of the scale in the eye-piece! But that is fortunately eliminated on reversal. . . .

## LECTURES AT BERKELEY.

The following course of lectures was given this term by members of the Lick Observatory staff before the class in Modern Astronomy at the University of California:—

Professor R. H. TUCKER—Tuesday, March 24th, and Thursday, March 26th. Subject, "Meridian Circle Work."

Professor R. G. AITKEN—Tuesday, March 31st; subject, "The Rings of *Saturn.*" Thursday, April 2d; subject, "On Double Stars."

Professor C. D. PERRINE—Tuesday, April 14th, and Thursday, April 16th. Subject, "The Lick Observatory Crocker Eclipse Expedition to Flint Island to Observe the Solar Eclipse of January 3, 1908."

A. O. LEUSCHNER.

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[1] With the Stackpole machine the probable error of a position, for a good object, does not exceed 0.00004 inch. Our experience with this machine has shown that we can make the settings on good star images with greater accuracy than we can read the scales. It was for this reason that I suggested, in my letter, that the interval between scale divisions should be 0.01 mm instead of 0.025 mm. This would increase the accuracy of reading the scales two and a half times, which, for present purposes at least, would be entirely ample. This also conserves the point, upon which we lay considerable stress, of making all our readings at the same point and very close to the optical axis of the microscope.—S. A.